

## PATENT ABSTRACTS OF JAPAN

(11)Publication number : 05-169181

(43)Date of publication of application : 09.07.1993

(51)Int.Cl.

B21K 1/76

B21C 37/15

(21)Application number : 03-337144

(71)Applicant :

TUBE FORMING:KK

(22)Date of filing : 19.12.1991

(72)Inventor :

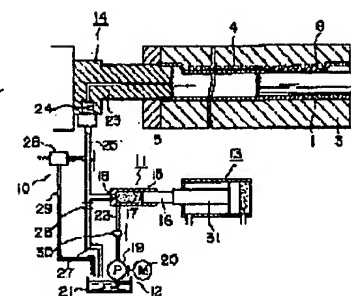
NAKAMURA MASANOBU

## (54) MANUFACTURE OF RACK BAR

## (57)Abstract:

PURPOSE: To smoothly press a punch into a pipe base stock by reducing the friction resistance in a sliding surface between the pipe base stock and the punch.

CONSTITUTION: By pressing the pipe base stock 1, flat surface part is formed in a longitudinal direction, and a rack pattern 4 is positioned to the outer surface of the flat surface part and successively, pressure oil is supplied in the pipe base stock 1 from the facing direction of the pipe base stock 1 to the press-in side of the punch 7 or the press-in side direction of the punch. Then, into the pipe base stock 1, the punch 7 forming the outer diameter smaller than the inner diameter of the pipe base stock 1 and the flat surface part corresponding to the flat surface part of the pipe base stock is pressed and the pressure oil is intruded and lubricated on the sliding surface between the pipe base stock 1 and the punch 7 to reduce the friction resistance, and the rack teeth pattern 8 is formed on the flat surface part of the pipe base stock 1.



## LEGAL STATUS

[Date of request for examination]

06.07.1998

[Date of sending the examiner's decision of rejection]

23.02.2001

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

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**CLAIMS**

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[Claim(s)]

[Claim 1] After locating in the external surface of said flat-surface section the rack mold which presses a pipe material, forms the flat-surface section in the longitudinal direction, and comes to form many tooth form in the direction which intersects perpendicularly in the direction of an axis of a pipe material, The punch with which the flat-surface section corresponding to said flat-surface section was formed while having the outer diameter is pressed fit. the interior of a pipe material -- the bore of a pipe material -- smallness -- In the manufacture approach of the rack bar which the flat-surface section of a pipe material is made to eat into a rack mold, and forms the rack tooth form by moving this punch relatively [ direction / of an axis / of a pipe material ] A pressure oil is supplied in a pipe material from the direction or punch press fit side direction which counters the punch press fit side of a pipe material. The manufacture approach of the rack bar characterized by making a pressure oil invade into the sliding surface of a pipe material and punch, performing lubrication, decreasing the frictional resistance between a pipe material and punch, and forming the rack tooth form in the flat-surface section of a pipe material.

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**DETAILED DESCRIPTION**

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[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the manufacture approach of a rack bar of making the rack tooth form forming in the external surface of a pipe material.

[0002]

[Description of the Prior Art] As the manufacture approach of the conventional rack bar, as shown in drawing 3 thru/or drawing 6 Set split molds 3 and 3 and it fixes so that the

flat-surface section 2 may be formed in the rack tooth-form formation part of the pipe material 1 and the rack molds 4 and 4 of split molds 3 and 3 may be beforehand located to this (refer to drawing 5 ) flat-surface section 2. After fixing the end of the pipe material 1 by the stopper 5, the punch 7 which has the flat-surface section 6 corresponding to the flat-surface section 2 of the pipe material 1 After applying a lubricating oil to the front face of punch 7, by pressing fit from the other end side of the pipe material 1, and making it move in the direction of an axis relatively, the meat of the flat-surface section 2 of the pipe material 1 is made to eat away to between the rack molds 4 and 4, the rack tooth form 8 is formed, and the rack bar 9 is manufactured.

[0003]

[Problem(s) to be Solved by the Invention] However, even if the frictional resistance when pressing punch 7 fit has applied the lubricating oil to the interior of the pipe material 1 by the above-mentioned conventional manufacture approach, since the oil film is thin, are large. Therefore, since the big force was needed for press fit, when equipment became large-sized, and galling occurred in the inner skin of the pipe material 1 which is a sliding surface, and the peripheral face of punch 7 or the punch 7 of a minor diameter was further used for them, there was a problem of punch 7 breaking.

[0004] In view of this, this invention is made for the purpose of offering the manufacture approach of the rack bar which can make frictional resistance small and can press it fit, when pressing punch fit to a pipe material.

[0005]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, it sets to this invention. After locating in the external surface of said flat-surface section the rack mold which presses a pipe material, forms the flat-surface section in the longitudinal direction, and comes to form many tooth form in the direction which intersects perpendicularly in the direction of an axis of a pipe material, The punch with which the flat-surface section corresponding to said flat-surface section was formed while having the outer diameter is pressed fit. the interior of a pipe material -- the bore of a pipe material -- smallness -- In the manufacture approach of the rack bar which the flat-surface section of a pipe material is made to eat into a rack mold, and forms the rack tooth form by moving this punch relatively [ direction / of an axis / of a pipe material ] A pressure oil is supplied in a pipe material from the direction or punch press fit side direction which counters the punch press fit side of a pipe material. It is characterized by making a pressure oil invade into the sliding surface of a pipe material and punch, performing lubrication, decreasing the frictional resistance between a pipe material and punch, and forming the rack tooth form in the flat-surface section of a pipe material.

[0006]

[Function] A pipe material is pressed, the flat-surface section is formed in some shaft orientations, and a rack mold is located in the external surface of the flat-surface section. Subsequently, while supplying a pressure oil toward the punch in a pipe material from the direction which counters the punch press fit side of a pipe material By pressing punch fit in the interior of a pipe material, and moving punch relatively [ direction / of an axis / of a pipe material ] A pressure oil invades into the sliding surface between a pipe material and punch, frictional resistance decreases, punch is smoothly pressed fit in a pipe material, the meat of the flat-surface section of a pipe material eats into a rack mold, and the rack tooth form is formed in the flat-surface section of a pipe material.

[0007]

[Example] Hereafter, one example of the pressure-oil feeder for enforcing the manufacture approach of this invention is omitted and explained about the same component as the conventional technique with reference to drawing 1.

[0008] The pressure-oil feeder 10 has the plunger pump 11, the oil feeder 12 to this plunger pump 11, the oil hydraulic cylinder 13 prepared by linking with a plunger pump 11 directly in order to operate a plunger pump 11, and the joint member 14 with which the side which counters a split mold 3 punch 7 insertion-side is equipped. and this joint member 14 -- the edge circles of a stopper 5 or a stopper 5 to the pipe material 1 -- liquid -- it is inserted densely.

[0009] The plan SHISHA pump 11 has casing 15 and plan SHIJA 16, and the inlet 17 and the delivery 18 are established in casing 15. An oil feeder 12 has a pump 19, a motor 20, and a tank 21, and the introductory tubing 22 for introducing the lubricating oil sucked up with the pump 19 driven by the motor 20 from a tank 21 in casing 15 is connected to the inlet 17 of the casing 15 of the plan SHIJA pump 11.

[0010] Moreover, between the delivery 18 and the inlet 24 of the joint member 14 in which the passage 23 of a L character configuration is formed, the supply pipe 25 for supplying the lubricating oil to which the pressure rose within casing 15 by plan SHIJA 16 toward the pipe material 1 and punch 7 in a split mold 3 is formed. And the return tubing 27 is connected to this supply pipe 25 toward the tank 21 through the bulb 26. Moreover, in order to hold uniformly the pressure of a pressure oil with the plan SHIJA pump 11 to a supply pipe 25, the leak bulb 28 for returning a part of pressure oil to a tank 21 is formed, it returns between this leak bulb 28 and tank 21, and tubing 29 is formed. In addition, 30 shows the check valve. Moreover, the piston rod 31 of an oil hydraulic cylinder 13 is formed in the end section of a plunger 16 at one, and this piston rod 31 operates according to the hydraulic power unit which is not illustrated.

[0011] Next, an operation of this pressure-oil feeder 10 is explained.

[0012] First, a motor 20 is driven, the lubricating oil in a tank 21 is introduced into the casing 15 of a plunger pump 11 from an inlet 17 with a pump 19, and, subsequently a pressure oil is supplied to the posterior part of the piston rod 31 of an oil hydraulic cylinder 13 according to a hydraulic power unit. Then, since a piston rod 31 moves forward, plan SHIJA 16 of the plan SHIJA pump 11 also moves forward, and the lubricating oil in casing 15 raises a pressure, and is sent towards the punch 7 in the pipe material 1 through the passage 23 of the joint member 14 through a supply pipe 25 from the delivery 18 of casing 15. Here, a pressure oil invades into the sliding surface between the inner skin of the pipe material 1, and the peripheral face of punch 7, the lubrication of the sliding surface is carried out, frictional resistance decreases, and punch 7 is smoothly pressed fit in the pipe material 1. And the meat of the flat-surface section 2 of the pipe material 1 eats into the rack mold 4, and the rack tooth form 8 is formed in the flat-surface section 2 of the pipe material 1. If the pressure of the inside of the pipe material 1 rises rather than a regular pressure by press fit of the punch 7 to the pipe material 1 here, the leak bulb 28 serves as open, a pressure oil will be returned to a tank 21 from the return tubing 29, and a pressure will turn into a regular pressure.

[0013] Moreover, after the rack tooth form 8 is formed in the pipe material 1, while moving punch 7 rightward [ of drawing 1 ], a pressure oil is supplied to the anterior part of the piston rod 31 of an oil hydraulic cylinder 13, and a piston rod 31 is moved

rightward [ of drawing 1 ]. And the lubricating oil in the pipe material 1 is dropped in a tank 21 through a supply pipe 25 and the return tubing 27 by making a bulb 26 open. [0014] Drawing 2 can form a stopper 5 in the edge of a split mold 3 while forming the passage 32 of the lubricating oil which is open for free passage from the end face of punch 7 in punch 7 in a peripheral face proper place, it can show this stopper 5 the case where the introductory way 33 of a lubricating oil is formed, and can perform more smoothly the lubrication of the sliding surface between the inner skin of the pipe material 1, and the peripheral face of punch 7 by these. In addition, although the case where passage 32 and the introductory way 33 were used for coincidence in drawing 2 was shown, you may use together with the example which may use what formed each separately and is shown in drawing 1 , and it is not limited to these.

[0015]

[Effect of the Invention] As explained above, this invention supplies a pressure oil in a pipe material from the direction which counters the punch press fit side of a pipe material, or a punch press fit side direction. Since it considered as the approach of pressing punch fit to a pipe material, having made oil pressure invade into the sliding face-to-face of a pipe material and punch, and performing lubrication Since the force which the frictional resistance between a pipe material and punch decreases, and stuffs punch into a pipe material can be made small, pushing equipment can be small and can be made cheap. Moreover, since the force with punch impossible for is not added, the breakage accident of punch decreases and there is effectiveness which was [ raise / productivity / sharply ] excellent.

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**TECHNICAL FIELD**

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[Industrial Application] This invention relates to the manufacture approach of a rack bar of making the rack tooth form forming in the external surface of a pipe material.

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## PRIOR ART

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[Description of the Prior Art] As the manufacture approach of the conventional rack bar, as shown in drawing 3 thru/or drawing 6 Set split molds 3 and 3 and it fixes so that the flat-surface section 2 may be formed in the rack tooth-form formation part of the pipe material 1 and the rack molds 4 and 4 of split molds 3 and 3 may be beforehand located to this (refer to drawing 5) flat-surface section 2. After fixing the end of the pipe material 1 by the stopper 5, the punch 7 which has the flat-surface section 6 corresponding to the flat-surface section 2 of the pipe material 1 After applying a lubricating oil to the front face of punch 7, by pressing fit from the other end side of the pipe material 1, and making it move in the direction of an axis relatively, the meat of the flat-surface section 2 of the pipe material 1 is made to eat away to between the rack molds 4 and 4, the rack tooth form 8 is formed, and the rack bar 9 is manufactured.

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## EFFECT OF THE INVENTION

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[Effect of the Invention] As explained above, this invention supplies a pressure oil in a pipe material from the direction which counters the punch press fit side of a pipe material, or a punch press fit side direction. Since it considered as the approach of pressing punch fit to a pipe material, having made oil pressure invade into the sliding face-to-face of a pipe material and punch, and performing lubrication Since the force which the frictional resistance between a pipe material and punch decreases, and stuffs punch into a pipe material can be made small, pushing equipment can be small and can be made cheap. Moreover, since the force with punch impossible for is not added, the breakage accident of punch decreases and there is effectiveness which was [ raise / productivity / sharply ] excellent.

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**TECHNICAL PROBLEM**

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[Problem(s) to be Solved by the Invention] However, even if the frictional resistance when pressing punch 7 fit has applied the lubricating oil to the interior of the pipe material 1 by the above-mentioned conventional manufacture approach, since the oil film is thin, are large. Therefore, since the big force was needed for press fit, when equipment became large-sized, and galling occurred in the inner skin of the pipe material 1 which is a sliding surface, and the peripheral face of punch 7 or the punch 7 of a minor diameter was further used for them, there was a problem of punch 7 breaking.

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**MEANS**

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[Means for Solving the Problem] In order to attain the above-mentioned purpose, it sets to this invention. After locating in the external surface of said flat-surface section the rack mold which presses a pipe material, forms the flat-surface section in the longitudinal direction, and comes to form many tooth form in the direction which intersects perpendicularly in the direction of an axis of a pipe material, The punch with which the

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**OPERATION**

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[Function] A pipe material is pressed, the flat-surface section is formed in some shaft orientations, and a rack mold is located in the external surface of the flat-surface section. Subsequently, while supplying a pressure oil toward the punch in a pipe material from the direction which counters the punch press fit side of a pipe material By pressing punch fit in the interior of a pipe material, and moving punch relatively [ direction / of an axis / of a pipe material ] A pressure oil invades into the sliding surface between a pipe material and punch, frictional resistance decreases, punch is smoothly pressed fit in a pipe material, the meat of the flat-surface section of a pipe material eats into a rack mold, and the rack tooth form is formed in the flat-surface section of a pipe material.

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## EXAMPLE

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[Example] Hereafter, one example of the pressure-oil feeder for enforcing the manufacture approach of this invention is omitted and explained about the same component as the conventional technique with reference to drawing 1.

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[0013] Moreover, after the rack tooth form 8 is formed in the pipe material 1, while

moving punch 7 rightward [ of drawing 1 ], a pressure oil is supplied to the anterior part of the piston rod 31 of an oil hydraulic cylinder 13, and a piston rod 31 is moved rightward [ of drawing 1 ]. And the lubricating oil in the pipe material 1 is dropped in a tank 21 through a supply pipe 25 and the return tubing 27 by making a bulb 26 open. [0014] Drawing 2 can form a stopper 5 in the edge of a split mold 3 while forming the passage 32 of the lubricating oil which is open for free passage from the end face of punch 7 in punch 7 in a peripheral face proper place, it can show this stopper 5 the case where the introductory way 33 of a lubricating oil is formed, and can perform more smoothly the lubrication of the sliding surface between the inner skin of the pipe material 1, and the peripheral face of punch 7 by these. In addition, although the case where passage 32 and the introductory way 33 were used for coincidence in drawing 2 was shown, you may use together with the example which may use what formed each separately and is shown in drawing 1 , and it is not limited to these.

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**DESCRIPTION OF DRAWINGS**

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[Brief Description of the Drawings]

[Drawing 1] The vertical section side elevation showing one example of the pressure-oil feeder for enforcing the manufacture approach of the rack bar of this invention.

[Drawing 2] The vertical section side elevation at the time of forming a pressure-oil supply way in punch and a stopper.

[Drawing 3] The vertical section side elevation of the equipment for enforcing the manufacture approach of the conventional rack bar.

[Drawing 4] The A-A line sectional view of drawing 3 .

[Drawing 5] The perspective view which performed flat-surface section processing for the pipe material.

[Drawing 6] The perspective view showing the pipe material with which the rack tooth form was formed.

[Description of Notations]

1 Pipe Material

2 Flat-Surface Section

4 Rack Mold

7 Punch

9 Rack Bar

10 Pressure-Oil Feeder  
11 Plan SHIJA Pump  
13 Oil Hydraulic Cylinder  
14 Joint Member

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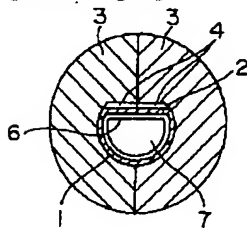
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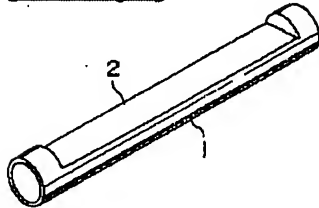
**DRAWINGS**

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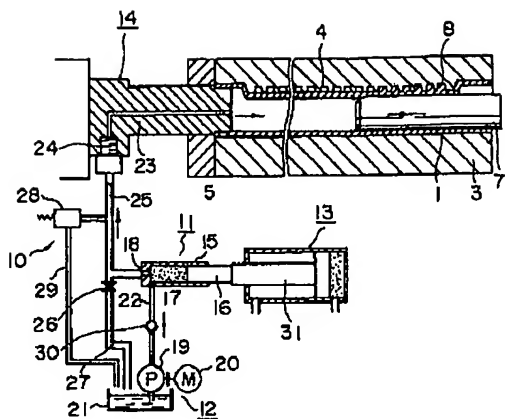
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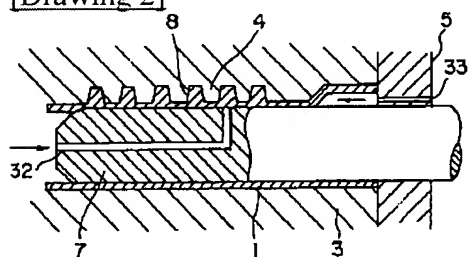
[Drawing 5]



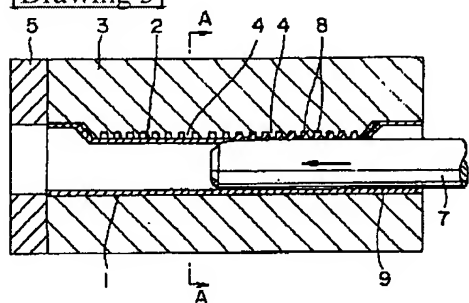
[Drawing 1]



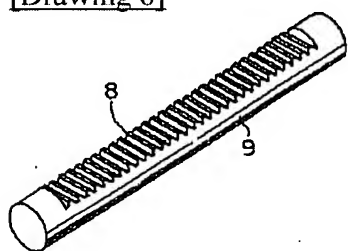
[Drawing 2]



[Drawing 3]



[Drawing 6]



[Translation done.]

(19)日本国特許庁 (J P)

(12) 公 開 特 許 公 報 (A)

(11)特許出願公開番号

特開平5-169181

(43)公開日 平成5年(1993)7月9日

(51)Int.Cl.<sup>5</sup>

識別記号

庁内整理番号

F I

技術表示箇所

B 2 1 K 1/76

A 6921-4E

B 2 1 C 37/15

B 6778-4E

審査請求 未請求 請求項の数1(全 4 頁)

(21)出願番号 特願平3-337144

(22)出願日 平成3年(1991)12月19日

(71)出願人 591285170

株式会社チューブフォーミング

神奈川県横浜市金沢区福浦2丁目15番地の  
12

(72)発明者 中 村 正 信

神奈川県鎌倉市七里ヶ浜東2-10-2

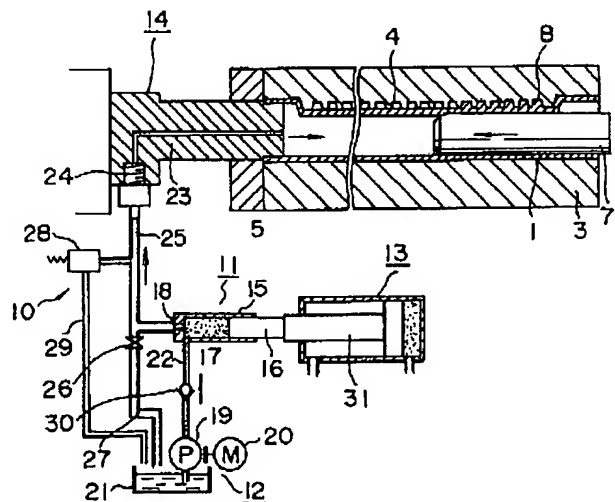
(74)代理人 弁理士 佐藤 一雄 (外3名)

(54)【発明の名称】 ラックバーの製造方法

(57)【要約】

【目的】 パイプ素材とポンチとの摺動面の摩擦抵抗を減少させてパイプ素材へポンチをスムーズに圧入させる。

【構成】 パイプ素材1を押圧してその長手方向に平面部2を形成し、ラック型4を平面部2の外面に位置させ、次いで、パイプ素材1のポンチ7圧入側に対向する方向あるいはポンチ圧入側方向よりパイプ素材1内に圧油を供給するとともに、パイプ素材1の内部にパイプ素材1の内径より小なる外径と平面部2に対応する平面部6の形成されたポンチ7を圧入し、パイプ素材1とポンチ7との間の摺動面に圧油を侵入させて潤滑し、摩擦抵抗を減少させてパイプ素材1の平面部2にラック歯型8を形成させる。



## 【特許請求の範囲】

【請求項 1】パイプ素材を押圧してその長手方向に平面部を形成し、パイプ素材の軸線方向に直交する方向に多数の歯型を形成してなるラック型を前記平面部の外面に位置させたのち、パイプ素材の内部にパイプ素材の内径より小なる外径を有するとともに前記平面部に対応する平面部が形成されたポンチを圧入し、このポンチをパイプ素材の軸線方向に相対的に移動させることによりパイプ素材の平面部をラック型に食い込ませてラック歯型を形成するラックバーの製造方法において、パイプ素材のポンチ圧入側に対向する方向あるいはポンチ圧入側方向よりパイプ素材内に圧油を供給し、パイプ素材とポンチとの摺動面に圧油を侵入させて潤滑を行い、パイプ素材とポンチとの間の摩擦抵抗を減少させてパイプ素材の平面部にラック歯型を形成することを特徴とするラックバーの製造方法。

## 【発明の詳細な説明】

## 【0001】

【産業上の利用分野】本発明は、パイプ素材の外面にラック歯型を形成させるラックバーの製造方法に関する。

## 【0002】

【従来の技術】従来のラックバーの製造方法としては、図 3 乃至図 6 に示すように、あらかじめ、パイプ素材 1 のラック歯型形成部位に平面部 2 を形成し（図 5 参照）この平面部 2 へ割型 3、3 のラック型 4、4 が位置するように割型 3、3 を合せて固着し、パイプ素材 1 の一端をストッパー 5 で固定したのち、パイプ素材 1 の平面部 2 に対応する平面部 6 を有するポンチ 7 を、ポンチ 7 の表面に潤滑油を塗布したのち、パイプ素材 1 の他端側から圧入して軸線方向へ相対的に移動させることにより、パイプ素材 1 の平面部 2 の肉をラック型 4、4 の間へ食い込ませてラック歯型 8 を形成し、ラックバー 9 を製造している。

## 【0003】

【発明が解決しようとする課題】しかるに上記従来の製造方法では、パイプ素材 1 の内部へポンチ 7 を圧入するときの摩擦抵抗が潤滑油を塗布していても油膜が薄いために大きく、したがって圧入に大きな力を必要とするので装置が大型になり、また、摺動面であるパイプ素材 1 の内周面及びポンチ 7 の外周面にかじりが発生したり、さらに、小径のポンチ 7 を使用する場合にはポンチ 7 が折損する等の問題があった。

【0004】本発明はこれに鑑み、パイプ素材へポンチを圧入するときに摩擦抵抗を小さくして圧入することのできるラックバーの製造方法を提供することを目的としてなされたものである。

## 【0005】

【課題を解決するための手段】上記の目的を達成するため本発明においては、パイプ素材を押圧してその長手方向に平面部を形成し、パイプ素材の軸線方向に直交する

方向に多数の歯型を形成してなるラック型を前記平面部の外面に位置させたのち、パイプ素材の内部にパイプ素材の内径より小なる外径を有するとともに前記平面部に対応する平面部が形成されたポンチを圧入し、このポンチをパイプ素材の軸線方向に相対的に移動させることによりパイプ素材の平面部をラック型に食い込ませてラック歯型を形成するラックバーの製造方法において、パイプ素材のポンチ圧入側に対向する方向あるいはポンチ圧入側方向よりパイプ素材内に圧油を供給し、パイプ素材とポンチとの摺動面に圧油を侵入させて潤滑を行い、パイプ素材とポンチとの間の摩擦抵抗を減少させてパイプ素材の平面部にラック歯型を形成することを特徴とするものである。

## 【0006】

【作用】パイプ素材を押圧して軸方向の一部に平面部を形成し、ラック型を平面部の外面に位置させる。次いで、パイプ素材のポンチ圧入側に対向する方向よりパイプ素材内のポンチに向かって圧油を供給するとともに、パイプ素材の内部にポンチを圧入し、ポンチをパイプ素材の軸線方向に相対的に移動させることにより、パイプ素材とポンチとの間の摺動面に圧油が侵入して摩擦抵抗が減少し、パイプ素材にポンチがスムーズに圧入され、パイプ素材の平面部の肉がラック型に食い込んでパイプ素材の平面部にラック歯型が形成される。

## 【0007】

【実施例】以下、本発明の製造方法を実施するための圧油供給装置の一実施例を図 1 を参照し、従来技術と同一の構成部分については省略して説明する。

【0008】圧油供給装置 10 は、プランジャポンプ 11 と、このプランジャポンプ 11 への給油装置 12 と、プランジャポンプ 11 を作動させるためにプランジャポンプ 11 に直結して設けられる油圧シリンダ 13 と、割型 3 のポンチ 7 挿入側に対向する側に装着される継手部材 14 とを有している。そして、この継手部材 14 は、ストッパー 5、又はストッパー 5 からパイプ素材 1 の端部に液密に挿着されている。

【0009】プランシジャポンプ 11 は、ケーシング 15 とプランシジャ 16 とを有し、ケーシング 15 には導入口 17 と吐出口 18 とが設けられている。給油装置 12 は、ポンプ 19、モーター 20 及びタンク 21 を有し、プランシジャポンプ 11 のケーシング 15 の導入口 17 にはタンク 21 からモーター 20 で駆動されるポンプ 19 により吸上げられた潤滑油をケーシング 15 内に導入するための導入管 22 が接続されている。

【0010】また、吐出口 18 と L 字形の流路 23 が形成されている継手部材 14 の導入口 24 との間には、プランシジャ 16 によりケーシング 15 内で圧力が上昇した潤滑油を割型 3 内のパイプ素材 1 とポンチ 7 に向かって供給するための供給管 25 が設けられている。そして、この供給管 25 にはバルブ 26 を介し戻し管 27 が

タンク 21 に向かって接続されている。また、供給管 25 にはプランシジャポンプ 11 による圧油の圧力を一定に保持するために、圧油の一部をタンク 21 へ戻すためのリークバルブ 28 が設けられており、このリークバルブ 28 とタンク 21 との間には戻し管 29 が設けられている。なお、30 は逆止弁を示している。また、プランシジャ 16 の一端部には油圧シリンダ 13 のピストンロッド 31 が一体に形成されており、このピストンロッド 31 は図示しない油圧源により作動するようになっている。

【0011】次に、この圧油供給装置 10 の作用について説明する。

【0012】先ず、モーター 20 を駆動してポンプ 19 によりタンク 21 内の潤滑油を導入口 17 からプランシジャポンプ 11 のケーシング 15 内へ導入し、次いで、油圧源により圧油を油圧シリンダ 13 のピストンロッド 31 の後部へ供給する。すると、ピストンロッド 31 が前進するのでプランシジャポンプ 11 のプランシジャ 16 も前進し、ケーシング 15 内の潤滑油は圧力を上昇させてケーシング 15 の吐出口 18 から供給管 25 を通り継手部材 14 の流路 23 を経てパイプ素材 1 内のポンチ 7 へ向けて送られる。ここで、パイプ素材 1 の内周面とポンチ 7 の外周面の間の摺動面に圧油が侵入して摺動面が潤滑され、摩擦抵抗が減少し、ポンチ 7 はパイプ素材 1 にスムーズに圧入される。そして、パイプ素材 1 の平面部 2 の肉はラック型 4 に食い込んでパイプ素材 1 の平面部 2 にラック歯型 8 が形成される。ここで、パイプ素材 1 へのポンチ 7 の圧入によりパイプ素材 1 の内面の圧力が規定の圧力よりも上昇すると、リークバルブ 28 が開となり、圧油は戻し管 29 からタンク 21 へ戻され、圧力は規定の圧力となる。

【0013】また、パイプ素材 1 にラック歯型 8 が形成されたのちは、ポンチ 7 を図 1 の右方向へ移動させるとともに油圧シリンダ 13 のピストンロッド 31 の前部に圧油を供給してピストンロッド 31 を図 1 の右方向へ移動させる。そして、バルブ 26 を開として供給管 25、戻し管 27 を経てパイプ素材 1 内の潤滑油をタンク 21 内に落下させる。

【0014】図 2 は、ポンチ 7 にポンチ 7 の端面から外周面適所に連通する潤滑油の流路 32 を形成するとともに割型 3 の端部にストッパ 5 を設け、このストッパ \*

\* 5 に潤滑油の導入路 33 を形成した場合を示すもので、これらによりパイプ素材 1 の内周面とポンチ 7 の外周面との間の摺動面の潤滑をよりスムーズに行うことができる。なお、図 2 においては流路 32 と導入路 33 とを同時に使用する場合を示したが、それぞれを別々に形成したものを使用してもよく、又、図 1 に示す実施例と併用してもよく、これらに限定されるものではない。

#### 【0015】

【発明の効果】以上説明したように本発明は、パイプ素材のポンチ圧入側に対向する方向あるいはポンチ圧入側方向からパイプ素材内に圧油を供給し、パイプ素材とポンチとの摺動面間に油圧を侵入させて潤滑を行いつつポンチをパイプ素材へ圧入する方法としたので、パイプ素材とポンチとの間の摩擦抵抗が減少しポンチをパイプ素材に押込む力を小さくすることができるので、押込装置は小型で安価にすることができる。また、ポンチに無理な力の加わることはないので、ポンチの折損事故が減少し、生産性を大巾に向上させることができるなどの優れた効果がある。

#### 【図面の簡単な説明】

【図 1】本発明のラックバーの製造方法を実施するための圧油供給装置の一実施例を示す縦断側面図。

【図 2】ポンチとストッパとに圧油供給路を形成した場合の縦断側面図。

【図 3】従来のラックバーの製造方法を実施するための装置の縦断側面図。

【図 4】図 3 の A-A 線断面図。

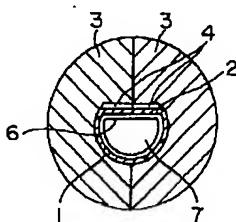
【図 5】パイプ素材に平面部加工を行った斜視図。

【図 6】ラック歯型の形成されたパイプ素材を示す斜視図。

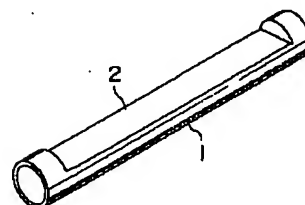
#### 【符号の説明】

- 1 パイプ素材
- 2 平面部
- 4 ラック型
- 7 ポンチ
- 9 ラックバー
- 10 圧油供給装置
- 11 プランシジャポンプ
- 13 油圧シリンダ
- 14 継手部材

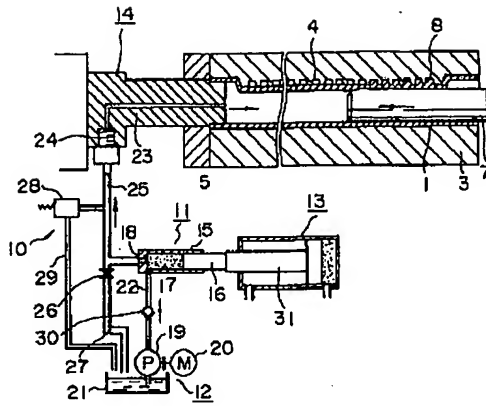
【図 4】



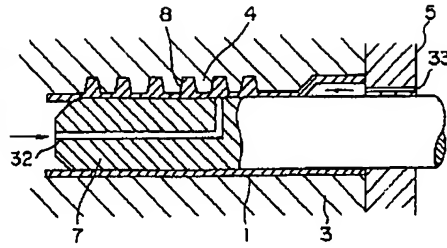
【図 5】



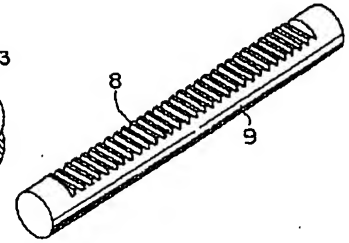
【図1】



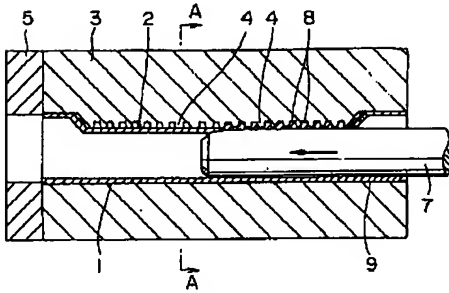
【図2】



【図6】



【図3】





## PATENT ABSTRACTS OF JAPAN

(11)Publication number : 06-246379

(43)Date of publication of application : 06.09.1994

(51)Int.Cl. B21D 53/86

B21C 23/08

B21C 37/15

B21J 5/12

B62D 3/12

(21)Application number : 04-158556

(71)Applicant : TUBE FORMING:KK

(22)Date of filing : 26.05.1992

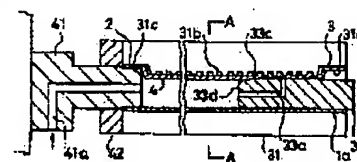
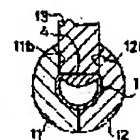
(72)Inventor : NAKAMURA MASANOBU

## (54) DEVICE AND METHOD FOR FORMING TUBE LIKE RACK BAR

## (57)Abstract:

PURPOSE: To produce a rack bar of light weight without hardly reducing the strength lower than the like cut from a round bar by forcibly inserting a core metal of semi-circular sectional shape in a hole of a metal tube set on a secondary forming split die, extruding and elongating a wall of outer circumference of an end part of the metal tube with a high pressure lubrication extruding device.

CONSTITUTION: An intermediate part of a metal tube is worked to a flat surface of semi-circular sectional shape with press forming, etc. Then, a thickness of a flat part 4 is made to a little thicker by being pressed. When it is put in forming split dies 11, 12 making a supplement shape of the rack of projecting and recessing streaks in a vertical direction against the flat surface in this state and a mandrel 33 is inserted from a hole of the tube, the flat part 4 is formed in a rack like because the thick wall part of the flat part 4 is pushed up toward the projecting and recessing streaks with the pushing force of the mandrel 33. Because a rack has to be formed essentially by using a tube of thick wall, so the weight is large even if it is a tube. But, the tube can be made thinner by inserting the core metal in the hole of the tube and elongating an excess metal mass.



## LEGAL STATUS

[Date of request for examination] 09.06.1998

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number] 2928427

[Date of registration] 14.05.1999

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right] 14.05.2002

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**CLAIMS**

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[Claim(s)]

[Claim 1] After locating in the external surface of said flat-surface section the rack mold which presses a pipe material, forms the flat-surface section in the longitudinal direction, and comes to form many tooth form in the direction which intersects perpendicularly in the direction of an axis of a pipe material, The punch with which the flat-surface section corresponding to said flat-surface section was formed while having the outer diameter is pressed fit. the interior of a pipe material -- the bore of a pipe material -- smallness -- In the manufacture approach of the rack bar which the flat-surface section of a pipe material is made to eat into a rack mold, and forms the rack tooth form by moving this punch relatively [ direction / of an axis / of a pipe material ] A pressure oil is supplied in a pipe material from the direction or punch press fit side direction which counters the punch press fit side of a pipe material. The manufacture approach of the rack bar characterized by making a pressure oil invade into the sliding surface of a pipe material and punch, performing lubrication, decreasing the frictional resistance between a pipe material and punch, and forming the rack tooth form in the flat-surface section of a pipe material.

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[Translation done.]

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**DETAILED DESCRIPTION**

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[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the manufacture approach of a rack bar of making the rack tooth form forming in the external surface of a pipe material.

[0002]

[Description of the Prior Art] As the manufacture approach of the conventional rack bar, as shown in drawing 3 thru/or drawing 6 Set split molds 3 and 3 and it fixes so that the

flat-surface section 2 may be formed in the rack tooth-form formation part of the pipe material 1 and the rack molds 4 and 4 of split molds 3 and 3 may be beforehand located to this (refer to drawing 5 ) flat-surface section 2. After fixing the end of the pipe material 1 by the stopper 5, the punch 7 which has the flat-surface section 6 corresponding to the flat-surface section 2 of the pipe material 1 After applying a lubricating oil to the front face of punch 7, by pressing fit from the other end side of the pipe material 1, and making it move in the direction of an axis relatively, the meat of the flat-surface section 2 of the pipe material 1 is made to eat away to between the rack molds 4 and 4, the rack tooth form 8 is formed, and the rack bar 9 is manufactured.

[0003]

[Problem(s) to be Solved by the Invention] However, even if the frictional resistance when pressing punch 7 fit has applied the lubricating oil to the interior of the pipe material 1 by the above-mentioned conventional manufacture approach, since the oil film is thin, are large. Therefore, since the big force was needed for press fit, when equipment became large-sized, and galling occurred in the inner skin of the pipe material 1 which is a sliding surface, and the peripheral face of punch 7 or the punch 7 of a minor diameter was further used for them, there was a problem of punch 7 breaking.

[0004] In view of this, this invention is made for the purpose of offering the manufacture approach of the rack bar which can make frictional resistance small and can press it fit, when pressing punch fit to a pipe material.

[0005]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, it sets to this invention. After locating in the external surface of said flat-surface section the rack mold which presses a pipe material, forms the flat-surface section in the longitudinal direction, and comes to form many tooth form in the direction which intersects perpendicularly in the direction of an axis of a pipe material, The punch with which the flat-surface section corresponding to said flat-surface section was formed while having the outer diameter is pressed fit. the interior of a pipe material -- the bore of a pipe material -- smallness -- In the manufacture approach of the rack bar which the flat-surface section of a pipe material is made to eat into a rack mold, and forms the rack tooth form by moving this punch relatively [ direction / of an axis / of a pipe material ] A pressure oil is supplied in a pipe material from the direction or punch press fit side direction which counters the punch press fit side of a pipe material. It is characterized by making a pressure oil invade into the sliding surface of a pipe material and punch, performing lubrication, decreasing the frictional resistance between a pipe material and punch, and forming the rack tooth form in the flat-surface section of a pipe material.

[0006]

[Function] A pipe material is pressed, the flat-surface section is formed in some shaft orientations, and a rack mold is located in the external surface of the flat-surface section. Subsequently, while supplying a pressure oil toward the punch in a pipe material from the direction which counters the punch press fit side of a pipe material By pressing punch fit in the interior of a pipe material, and moving punch relatively [ direction / of an axis / of a pipe material ] A pressure oil invades into the sliding surface between a pipe material and punch, frictional resistance decreases, punch is smoothly pressed fit in a pipe material, the meat of the flat-surface section of a pipe material eats into a rack mold, and the rack tooth form is formed in the flat-surface section of a pipe material.

[0007]

[Example] Hereafter, one example of the pressure-oil feeder for enforcing the manufacture approach of this invention is omitted and explained about the same component as the conventional technique with reference to drawing 1 .

[0008] The pressure-oil feeder 10 has the plunger pump 11, the oil feeder 12 to this plunger pump 11, the oil hydraulic cylinder 13 prepared by linking with a plunger pump 11 directly in order to operate a plunger pump 11, and the joint member 14 with which the side which counters a split mold 3 punch 7 insertion-side is equipped. and this joint member 14 -- the edge circles of a stopper 5 or a stopper 5 to the pipe material 1 -- liquid -- it is inserted densely.

[0009] The plan SHISHA pump 11 has casing 15 and plan SHIJA 16, and the inlet 17 and the delivery 18 are established in casing 15. An oil feeder 12 has a pump 19, a motor 20, and a tank 21, and the introductory tubing 22 for introducing the lubricating oil sucked up with the pump 19 driven by the motor 20 from a tank 21 in casing 15 is connected to the inlet 17 of the casing 15 of the plan SHIJA pump 11.

[0010] Moreover, between the delivery 18 and the inlet 24 of the joint member 14 in which the passage 23 of a L character configuration is formed, the supply pipe 25 for supplying the lubricating oil to which the pressure rose within casing 15 by plan SHIJA 16 toward the pipe material 1 and punch 7 in a split mold 3 is formed. And the return tubing 27 is connected to this supply pipe 25 toward the tank 21 through the bulb 26. Moreover, in order to hold uniformly the pressure of a pressure oil with the plan SHIJA pump 11 to a supply pipe 25, the leak bulb 28 for returning a part of pressure oil to a tank 21 is formed, it returns between this leak bulb 28 and tank 21, and tubing 29 is formed. In addition, 30 shows the check valve. Moreover, the piston rod 31 of an oil hydraulic cylinder 13 is formed in the end section of a plunger 16 at one, and this piston rod 31 operates according to the hydraulic power unit which is not illustrated.

[0011] Next, an operation of this pressure-oil feeder 10 is explained.

[0012] First, a motor 20 is driven, the lubricating oil in a tank 21 is introduced into the casing 15 of a plunger pump 11 from an inlet 17 with a pump 19, and, subsequently a pressure oil is supplied to the posterior part of the piston rod 31 of an oil hydraulic cylinder 13 according to a hydraulic power unit. Then, since a piston rod 31 moves forward, plan SHIJA 16 of the plan SHIJA pump 11 also moves forward, and the lubricating oil in casing 15 raises a pressure, and is sent towards the punch 7 in the pipe material 1 through the passage 23 of the joint member 14 through a supply pipe 25 from the delivery 18 of casing 15. Here, a pressure oil invades into the sliding surface between the inner skin of the pipe material 1, and the peripheral face of punch 7, the lubrication of the sliding surface is carried out, frictional resistance decreases, and punch 7 is smoothly pressed fit in the pipe material 1. And the meat of the flat-surface section 2 of the pipe material 1 eats into the rack mold 4, and the rack tooth form 8 is formed in the flat-surface section 2 of the pipe material 1. If the pressure of the inside of the pipe material 1 rises rather than a regular pressure by press fit of the punch 7 to the pipe material 1 here, the leak bulb 28 serves as open, a pressure oil will be returned to a tank 21 from the return tubing 29, and a pressure will turn into a regular pressure.

[0013] Moreover, after the rack tooth form 8 is formed in the pipe material 1, while moving punch 7 rightward [ of drawing 1 ], a pressure oil is supplied to the anterior part of the piston rod 31 of an oil hydraulic cylinder 13, and a piston rod 31 is moved

rightward [ of drawing 1 ]. And the lubricating oil in the pipe material 1 is dropped in a tank 21 through a supply pipe 25 and the return tubing 27 by making a bulb 26 open. [0014] Drawing 2 can form a stopper 5 in the edge of a split mold 3 while forming the passage 32 of the lubricating oil which is open for free passage from the end face of punch 7 in punch 7 in a peripheral face proper place, it can show this stopper 5 the case where the introductory way 33 of a lubricating oil is formed, and can perform more smoothly the lubrication of the sliding surface between the inner skin of the pipe material 1, and the peripheral face of punch 7 by these. In addition, although the case where passage 32 and the introductory way 33 were used for coincidence in drawing 2 was shown, you may use together with the example which may use what formed each separately and is shown in drawing 1 , and it is not limited to these.

[0015]

[Effect of the Invention] As explained above, this invention supplies a pressure oil in a pipe material from the direction which counters the punch press fit side of a pipe material, or a punch press fit side direction. Since it considered as the approach of pressing punch fit to a pipe material, having made oil pressure invade into the sliding face-to-face of a pipe material and punch, and performing lubrication Since the force which the frictional resistance between a pipe material and punch decreases, and stuffs punch into a pipe material can be made small, pushing equipment can be small and can be made cheap. Moreover, since the force with punch impossible for is not added, the breakage accident of punch decreases and there is effectiveness which was [ raise / productivity / sharply ] excellent.

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## TECHNICAL FIELD

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[Industrial Application] This invention relates to the manufacture approach of a rack bar of making the rack tooth form forming in the external surface of a pipe material.

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## PRIOR ART

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[Description of the Prior Art] As the manufacture approach of the conventional rack bar, as shown in drawing 3 thru/or drawing 6 Set split molds 3 and 3 and it fixes so that the flat-surface section 2 may be formed in the rack tooth-form formation part of the pipe material 1 and the rack molds 4 and 4 of split molds 3 and 3 may be beforehand located to this (refer to drawing 5 ) flat-surface section 2. After fixing the end of the pipe material 1 by the stopper 5, the punch 7 which has the flat-surface section 6 corresponding to the flat-surface section 2 of the pipe material 1 After applying a lubricating oil to the front face of punch 7, by pressing fit from the other end side of the pipe material 1, and making it move in the direction of an axis relatively, the meat of the flat-surface section 2 of the pipe material 1 is made to eat away to between the rack molds 4 and 4, the rack tooth form 8 is formed, and the rack bar 9 is manufactured.

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## EFFECT OF THE INVENTION

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[Effect of the Invention] As explained above, this invention supplies a pressure oil in a pipe material from the direction which counters the punch press fit side of a pipe material, or a punch press fit side direction. Since it considered as the approach of pressing punch fit to a pipe material, having made oil pressure invade into the sliding face-to-face of a pipe material and punch, and performing lubrication Since the force which the frictional resistance between a pipe material and punch decreases, and stuffs punch into a pipe material can be made small, pushing equipment can be small and can be made cheap. Moreover, since the force with punch impossible for is not added, the breakage accident of punch decreases and there is effectiveness which was [ raise / productivity / sharply ] excellent.

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**TECHNICAL PROBLEM**

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[Problem(s) to be Solved by the Invention] However, even if the frictional resistance when pressing punch 7 fit has applied the lubricating oil to the interior of the pipe material 1 by the above-mentioned conventional manufacture approach, since the oil film is thin, are large. Therefore, since the big force was needed for press fit, when equipment became large-sized, and galling occurred in the inner skin of the pipe material 1 which is a sliding surface, and the peripheral face of punch 7 or the punch 7 of a minor diameter was further used for them, there was a problem of punch 7 breaking.

[0004] In view of this, this invention is made for the purpose of offering the manufacture approach of the rack bar which can make frictional resistance small and can press it fit, when pressing punch fit to a pipe material.

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**MEANS**

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[Means for Solving the Problem] In order to attain the above-mentioned purpose, it sets to this invention. After locating in the external surface of said flat-surface section the rack mold which presses a pipe material, forms the flat-surface section in the longitudinal direction, and comes to form many tooth form in the direction which intersects perpendicularly in the direction of an axis of a pipe material, The punch with which the

flat-surface section corresponding to said flat-surface section was formed while having the outer diameter is pressed fit. the interior of a pipe material -- the bore of a pipe material -- smallness -- In the manufacture approach of the rack bar which the flat-surface section of a pipe material is made to eat into a rack mold, and forms the rack tooth form by moving this punch relatively [ direction / of an axis / of a pipe material ] A pressure oil is supplied in a pipe material from the direction or punch press fit side direction which counters the punch press fit side of a pipe material. It is characterized by making a pressure oil invade into the sliding surface of a pipe material and punch, performing lubrication, decreasing the frictional resistance between a pipe material and punch, and forming the rack tooth form in the flat-surface section of a pipe material.

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**OPERATION**

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[Function] A pipe material is pressed, the flat-surface section is formed in some shaft orientations, and a rack mold is located in the external surface of the flat-surface section. Subsequently, while supplying a pressure oil toward the punch in a pipe material from the direction which counters the punch press fit side of a pipe material By pressing punch fit in the interior of a pipe material, and moving punch relatively [ direction / of an axis / of a pipe material ] A pressure oil invades into the sliding surface between a pipe material and punch, frictional resistance decreases, punch is smoothly pressed fit in a pipe material, the meat of the flat-surface section of a pipe material eats into a rack mold, and the rack tooth form is formed in the flat-surface section of a pipe material.

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## EXAMPLE

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[Example] Hereafter, one example of the pressure-oil feeder for enforcing the manufacture approach of this invention is omitted and explained about the same component as the conventional technique with reference to drawing 1 .

[0008] The pressure-oil feeder 10 has the plunger pump 11, the oil feeder 12 to this plunger pump 11, the oil hydraulic cylinder 13 prepared by linking with a plunger pump 11 directly in order to operate a plunger pump 11, and the joint member 14 with which the side which counters a split mold 3 punch 7 insertion-side is equipped. and this joint member 14 -- the edge circles of a stopper 5 or a stopper 5 to the pipe material 1 -- liquid -- it is inserted densely.

[0009] The plan SHISHA pump 11 has casing 15 and plan SHIJA 16, and the inlet 17 and the delivery 18 are established in casing 15. An oil feeder 12 has a pump 19, a motor 20, and a tank 21, and the introductory tubing 22 for introducing the lubricating oil sucked up with the pump 19 driven by the motor 20 from a tank 21 in casing 15 is connected to the inlet 17 of the casing 15 of the plan SHIJA pump 11.

[0010] Moreover, between the delivery 18 and the inlet 24 of the joint member 14 in which the passage 23 of a L character configuration is formed, the supply pipe 25 for supplying the lubricating oil to which the pressure rose within casing 15 by plan SHIJA 16 toward the pipe material 1 and punch 7 in a split mold 3 is formed. And the return tubing 27 is connected to this supply pipe 25 toward the tank 21 through the bulb 26. Moreover, in order to hold uniformly the pressure of a pressure oil with the plan SHIJA pump 11 to a supply pipe 25, the leak bulb 28 for returning a part of pressure oil to a tank 21 is formed, it returns between this leak bulb 28 and tank 21, and tubing 29 is formed. In addition, 30 shows the check valve. Moreover, the piston rod 31 of an oil hydraulic cylinder 13 is formed in the end section of a plunger 16 at one, and this piston rod 31 operates according to the hydraulic power unit which is not illustrated.

[0011] Next, an operation of this pressure-oil feeder 10 is explained.

[0012] First, a motor 20 is driven, the lubricating oil in a tank 21 is introduced into the casing 15 of a plunger pump 11 from an inlet 17 with a pump 19, and, subsequently a pressure oil is supplied to the posterior part of the piston rod 31 of an oil hydraulic cylinder 13 according to a hydraulic power unit. Then, since a piston rod 31 moves forward, plan SHIJA 16 of the plan SHIJA pump 11 also moves forward, and the lubricating oil in casing 15 raises a pressure, and is sent towards the punch 7 in the pipe material 1 through the passage 23 of the joint member 14 through a supply pipe 25 from the delivery 18 of casing 15. Here, a pressure oil invades into the sliding surface between the inner skin of the pipe material 1, and the peripheral face of punch 7, the lubrication of the sliding surface is carried out, frictional resistance decreases, and punch 7 is smoothly pressed fit in the pipe material 1. And the meat of the flat-surface section 2 of the pipe material 1 eats into the rack mold 4, and the rack tooth form 8 is formed in the flat-surface section 2 of the pipe material 1. If the pressure of the inside of the pipe material 1 rises rather than a regular pressure by press fit of the punch 7 to the pipe material 1 here, the leak bulb 28 serves as open, a pressure oil will be returned to a tank 21 from the return tubing 29, and a pressure will turn into a regular pressure.

[0013] Moreover, after the rack tooth form 8 is formed in the pipe material 1, while

moving punch 7 rightward [ of drawing 1 ], a pressure oil is supplied to the anterior part of the piston rod 31 of an oil hydraulic cylinder 13, and a piston rod 31 is moved rightward [ of drawing 1 ]. And the lubricating oil in the pipe material 1 is dropped in a tank 21 through a supply pipe 25 and the return tubing 27 by making a bulb 26 open. [0014] Drawing 2 can form a stopper 5 in the edge of a split mold 3 while forming the passage 32 of the lubricating oil which is open for free passage from the end face of punch 7 in punch 7 in a peripheral face proper place, it can show this stopper 5 the case where the introductory way 33 of a lubricating oil is formed, and can perform more smoothly the lubrication of the sliding surface between the inner skin of the pipe material 1, and the peripheral face of punch 7 by these. In addition, although the case where passage 32 and the introductory way 33 were used for coincidence in drawing 2 was shown, you may use together with the example which may use what formed each separately and is shown in drawing 1 , and it is not limited to these.

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**DESCRIPTION OF DRAWINGS**

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[Brief Description of the Drawings]

[Drawing 1] The vertical section side elevation showing one example of the pressure-oil feeder for enforcing the manufacture approach of the rack bar of this invention.

[Drawing 2] The vertical section side elevation at the time of forming a pressure-oil supply way in punch and a stopper.

[Drawing 3] The vertical section side elevation of the equipment for enforcing the manufacture approach of the conventional rack bar.

[Drawing 4] The A-A line sectional view of drawing 3 .

[Drawing 5] The perspective view which performed flat-surface section processing for the pipe material.

[Drawing 6] The perspective view showing the pipe material with which the rack tooth form was formed.

[Description of Notations]

1 Pipe Material

2 Flat-Surface Section

4 Rack Mold

7 Punch

9 Rack Bar

- 10 Pressure-Oil Feeder
- 11 Plan SHIJA Pump
- 13 Oil Hydraulic Cylinder
- 14 Joint Member

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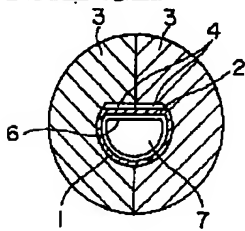
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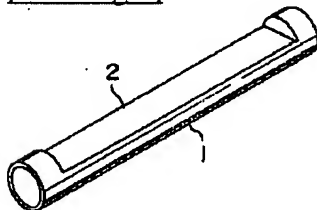
**DRAWINGS**

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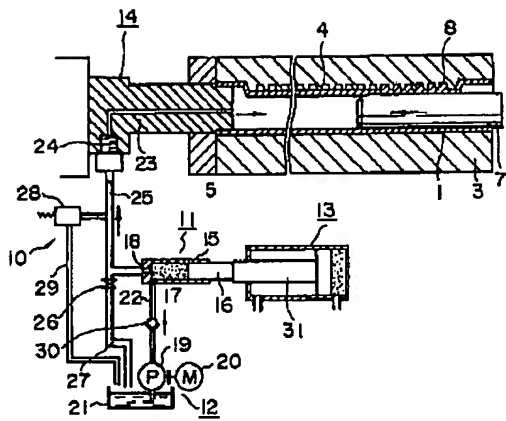
[Drawing 4]



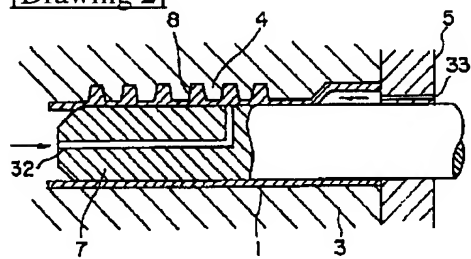
[Drawing 5]



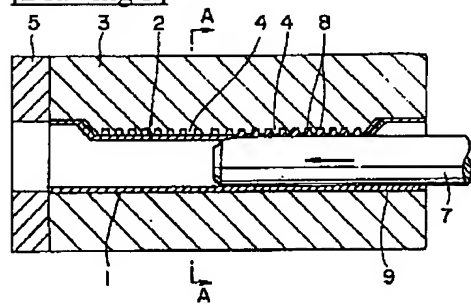
[Drawing 1]



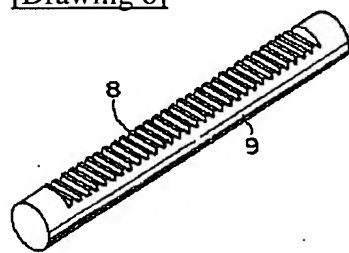
[Drawing 2]



[Drawing 3]



[Drawing 6]



[Translation done.]

(19)日本国特許庁(JP)

(12) 公開特許公報(A)

(11)特許出願公開番号

特開平6-246379

(43)公開日 平成6年(1994)9月6日

(51)Int.Cl. <sup>5</sup>	識別記号	庁内整理番号	F I	技術表示箇所
B 2 1 D 53/86		A 7047-4E		
B 2 1 C 23/08		A 7511-4E		
37/15		A 8718-4E		
B 2 1 J 5/12		Z 8718-4E		
B 6 2 D 3/12		9142-3D		

審査請求 未請求 請求項の数 7 F D (全 6 頁)

(21)出願番号 特願平4-158556

(22)出願日 平成4年(1992)5月26日

(71)出願人 591285170

株式会社チューブフォーミング

神奈川県横浜市金沢区福浦2丁目15番地の  
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(72)発明者 中村 正信

神奈川県鎌倉市七里ヶ浜東2丁目10番2号

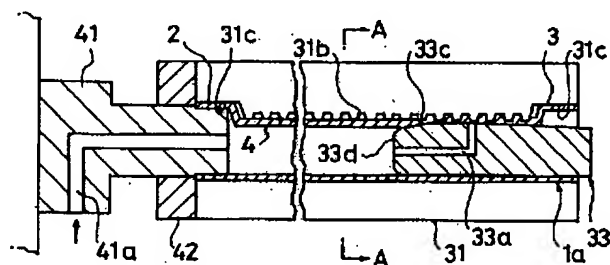
(74)代理人 弁理士 稲木 次之 (外1名)

(54)【発明の名称】 チューブ状のラックバーを成型する装置及びその方法

(57)【要約】 (修正有)

【目的】金属管を素材として、高強度、軽量なステアリングラックバーの成型装置及び方法の提供。

【構成】第1成形割型管を挿入し、プレス型により、1次成形を行ない、次いで内面の一部にラック歯に対応する歯を有する第2次成形割型に1次成形材を挿入し、一端から半円形のマンドレル33を圧入し、ラック歯を成形し、2次成形材に芯金を挿入し、押出しダイスにより管端部の肉を伸ばすことにより、一層の軽量化を図る。



## 【特許請求の範囲】

【請求項1】 円筒状の空洞を有し、得ようとするラックの幅と同幅の溝が空洞に連続して形成された第1成型割型と、該割型の溝にチューブが挿入されたときに圧入されるプレス型と、得ようとするラックバーと補形をなし、内部の軸線に対して直交する方向にラックの歯に対応する凹凸条部が形成された第2次成型割型と、第2次成型割型に装着されたチューブの穴から圧入される断面半円状のマンドレルと、第2次成型後のチューブの穴に挿入される芯金挿入手段及び芯金を挿入した状態でチューブに外周から圧力をかけると共にスライド移動することによりチューブの両端の肉を押し伸ばす高圧強制潤滑押出し加工装置とからなる金属チューブからラックバーを製造する装置。

【請求項2】 前記第1割型に装着されたチューブに被変形表面を加熱する手段を有することを特徴とする請求項1記載の金属チューブからラックバーを製造する装置。

【請求項3】 芯金挿入手段がディスク上の中心から所定の距離はなれた円弧上に所定の間隔でディスクに垂直に接合された複数の芯金と、前記ディスクの中心部と接続され間欠的に回転すると共に回転軸方向に伸縮する駆動手段とからなることを特徴とする請求項1記載の金属チューブからラックバーを製造する装置。

【請求項4】 比較的肉厚の金属製チューブの一部に外周から圧力をかけて断面半円状のラック形成部を製造する工程と、前記加工されたチューブを内部に得ようとするラックと補形をなす凹凸条を有する成型割型に装着し、該金属製チューブの穴から断面半円状のマンドレルを圧入することによりラックを形成する工程と、前記工程の後に金属製チューブの端部に芯金を送入した後に内周に圧延用のダイスを有する高圧潤滑押出し装置に装着して、端部の金属チューブの肉を押し延ばし金属製チューブの端部を薄化する工程とからなる金属チューブからラックバーを製造する方法。

【請求項5】 金属製チューブを加圧して変形する前に予め変形させようとする部分を加熱することを特徴とする請求項4記載の金属チューブからラックバーを製造する方法。

【請求項6】 芯金の金属製チューブへの挿入を芯金を複数設け、複数回に一回の割合で塑性加工に使用することを特徴とする請求項4記載の金属チューブからラックバーを製造する方法。

【請求項7】 挿入する芯金がテーパ状のものを使用することを特徴とする請求項4記載の金属チューブからラックバーを製造する方法。

## 【発明の詳細な説明】

## 【0001】

【産業上の利用分野】 本発明は、金属製チューブからラックバーを製造することに関して強度的に劣らず、重量

を半分以下に軽量化できる製造方法及び装置に関するものである。

## 【0002】

【従来技術】 従来の自動車のステアリングラックバーの製造方法としては、図14に見られるように円柱状の丸棒50の一部を平坦な半円柱状に切削し、さらに該平坦部を切削することによりその表面にラック50aを製造する方法が採られている。

## 【0003】

【発明が解決しようとする課題】 しかしながら従来の製造方法によるラックバーは、鋼鉄等の金属棒の表面の一部を切削することにより製造されている関係から、重量がかさむと共に高価になるといった不都合がある。また最近の自動車の製造に際しては、燃費、安全性の観点からあらゆる部品に関して軽量でかつ強度的に優れたものが望まれている。そこで本発明は、かかる従来技術の欠点を鑑みなされたもので、従来の丸棒を切削したものよりも強度が劣らず、かつ重量を半分以下に抑えることのできる金属チューブを素材としたラックバーの製造方法及び装置を提供することにある。他の目的は、従来のものに比較して製造方法が簡単で、かつ製造コストが安価なものを提供することにある。一般にラックバーを軽量化するためにチューブの肉厚の薄いものを採用し、これに型を用いてラックを形成することが考えられるが、ラックを形成する時にその部分が薄くなりすぎ、強度的に問題がある。またラックを十分な厚みをもって形成するために肉厚の素材を用いれば強度的に優れたものとなるが、軽量化を十分に達成することにはならない。そこで鋭意検討した結果、本発明を完成させたものである。

## 【0004】

【課題を解決するための手段】 本発明に関して、上記目的を以下に示す方法及び装置で達成する。すなわち、以下の各工程、比較的肉厚の金属製チューブの外周部分に圧力をかけて両端が断面円形のままで中央部を断面半円形状の平坦な面に加工する工程、前記平坦な面を有するチューブをその平坦な面に軸に対して垂直に凹凸条を有するラックの補形をなす成型用割型に入れ、その後チューブの穴に断面半円状のマンドレルを押し込み割型の凹凸条に合わせて平坦な面にラックを成型する工程と、ラック成型後にチューブの素材の端部の穴に芯金を挿入した状態で、チューブの外周を内周にダイスを有する割型で加圧しながらチューブの肉を半分程度押し伸ばす工程とからなる。次に製造する装置としては、金属チューブの外径と同径の円柱状の空洞を有し上方からチューブの中央部を断面半円形状に加圧変形させる第1次成型用割型と、第1次成型用割型から取り出された金属チューブが収容される内壁に所定のピッチでラックの凹凸条を有する第2次成型割型と、該第2次成型割型に装着された金属チューブの穴に加圧挿入される断面半円状の芯金

と、前記金属チューブの端部の外周の肉圧を芯金を挿入した状態で加圧しながら押し伸ばす高圧潤滑押し加工装置とからなる装置により本目的を達成する。尚、端部に挿入される芯金の形状は断面円形状である。

#### 【0005】

【作用】本発明にかかる装置及び方法では、金属製チューブの中間部をプレス加工等により断面半円形状の平坦な面に加工する。すると押圧により平坦部の肉圧は若干厚めになる。その状態で平面に対して垂直方向に凹凸条のラックの補形をなす成型用割型に入れ、チューブの孔からマンドレルを挿入するとマンドレルの押す力により平坦部の肉厚部が凹凸条に向けて押し上げられるので、平坦部がラック形状に成型される。もともと肉厚のチューブを用いてラックを成型しなければならないためにチューブといっても重量はかさむ。そこで、チューブの穴に心金を挿入することによりチューブが圧縮されない状態にして、高圧潤滑押し装置により余分な金属の肉を引き伸ばすことにより、チューブは肉薄となる。

#### 【0006】

【実施例】以下に本発明を図示された実施例に従って詳細に説明する。図1は、本発明に製造に使用する肉厚の素材からなる金属製チューブ1の斜視図であり、該チューブ1は図2及び図3に示されるような左右対称をなす一対の半円筒状の第1次成型用割型11、12に装着される。成型用割型11、12は図示されるように下部対向面11a、12a同士は、互いに隙間なく当接し、かつ垂直をなす上部対向面11b、12bは、これから得ようとするラックバーの凹凸条5の幅に略等しい間隔をもって、互いに側方に引き込んでいる。各割型11、12の上下の対向面11b、12b、11a、12aの間は、凹入円弧面11c、12cとなっている。

【0007】前記凹入円弧面11c、12c内に、得ようとするラックバーとほぼ同径をなす金属チューブ1を、弛みなく嵌合してから両割型11、12を互いに結合する。次に上部対向面11b、12b間に露出する金属チューブ1の上面部1aを図示しない加熱手段にて加熱し、軟化させる。尚、加熱しなくても加工することができるが、肉厚のものになればなるほど加熱した方がよい。この状態において割型11、12の上部対向面11b、12bの間に得ようとするラックバーの平面部と略等しい長さの角杆状プレス型13を圧入して、金属チューブ1の上面部1aをプレス加工により断面半円状に変形させる。

【0008】すると図3及び図4に示すように、両端部2、3は断面円形をなし、かつその間に得ようとするラックバーの凹凸条5の幅と同幅で、かつ所要の長さの平面部4を備えた第1次成型体1bが成型される。この際、金属チューブ1の上面部1aは、加熱により軟化されている関係で、形成される平面部4の裏側は、中央部が肉厚の凸レンズ状に盛り上がった状態となる(図3)。

次に図5及び図6は、得ようとするラックが型とられた

左右一対の第2次成型用割型31、32であり、両割型31、32は共に半円筒状をなし、その対向面における凹入孔31a、32aの上面は、両端を除いて、チューブ1の軸線と直交し、かつラックバーの凹凸条5に対応する凹凸部31b、32bが形成されている。凹入孔31a、32aの両端部は合体して、第1次成型体1aの端部2、3と略等形でかつ同径の円形部となるように半円形部31c、32cとなっている。

【0009】33は、先端部がテーパ状で次第に高くなるように形成された金属チューブ1の内径と等しい半円柱状のマンドレルであり、その先端33dは第1次成型体の穴径より僅かに小さく形成してあり、先端部からその外周面に連通する潤滑油の流路33aを有する。また前述チューブの凸レンズ状に盛り上がった面と当接する部分には、凸レンズ状の部分を凹凸部31a、31bに向けて押し上げるように傾斜部33cが形成されている。

【0010】この第2次成型用割型31、32内に、前記第1次成型体1aを内嵌すると共に、第2次成型用割型31、32を固結し、ついで第1次成型体内に図の右端よりマンドレル33を潤滑油を供給しながら強制的に圧入する。するとマンドレル33の傾斜部33cより、第1次成型体1aの平坦部4のみが上に押し上げられて、その外周面の肉が割型31、32の凹凸面31b、32bに食い込み、歯列状に塑性変形して図7に示すようなラックバーが得られる。

【0011】尚本実施例では、第2次成型の際に、第1次成型体1bが左側に抜け出るのを防ぐために、図5に示すように第2次成型用割型31、32の左端面に中心に孔を有するストッパー42を当接させている。ストッパー42とストッパー42に当接するチューブ1と液密にアダプター41が嵌挿されており、該アダプター41に穿孔された流路41aを介して図示しない供給装置から所定圧力の潤滑油がチューブ1に供給されるようになっている。

【0012】図7に示すように自動車のハンドル操作を前車輪に伝えるステアリング機構の場合は、ラックを形成しない中空の部分が長めに成型される。そしてチューブの素材を比較的肉厚のもので形成した場合には、いくらチューブといえども自動車の重量に影響を与えることになる。そこで、本発明ではチューブの肉厚を薄くする溜めに次のような方法及び手段が施されている。

【0013】すなわち第2次成型体の両端のチューブ1内にチューブの内径と略同径の円柱状の芯金44を挿入し、その後に内周に断面台形状の加工部46(ダイス)が形成され第2次成型体の円筒状の外周を上下から略50トンの圧力で押さえ込む割型48、49(高圧潤滑押し加工装置)に内嵌し、該割型48、49を水平移動させることにより金属チューブ1の外周表面をしごき伸ばす。加工部46は超硬鋼で形成するのがよく、また図9に示すように加工部46は一方がチューブ表面と直角に近い角で、他方がチューブ表面に対して5~20度の範囲の鋭角になるように形成されており、また接触面の幅Dは3~10mm程度

とするのが好ましい。尚、割型を用いてチューブの肉を押し伸ばす場合は、圧力と摩擦との関係から、チューブが加熱しすぎ、脆くなるので500~10000kg/cm<sup>2</sup>の潤滑油等を割型の通路50から注入する。また芯金44を挿入してチューブの肉を押し伸ばす場合に、芯金44自体を冷却する為に次のラックバーを製造するまでに芯金44を冷却する時間を必要とする。

【0014】そこで、本発明では図10に示すようにディスク52に円柱状からなる複数本の芯金44を垂直に接合したものと、該ディスク52の中心部とロッド56を介して接続されたディスク52を間欠的に回転すると共に軸方向に伸縮させる駆動装置54とからなり、一つの芯金44をチューブ外周面のしごき加工に用いた後に、ディスク52を所定角度回転させ、新たな芯金44を挿入し、しごき加工に用いるように構成されている。

【0015】以上述べた構成において本発明の本実施例の装置を用いたラックバーの製法について詳細に説明する。

①平坦部を形成する部分を予め加熱し軟化させる。これによりプレス型を圧入した際に平坦部4の裏面を凸レンズ状に盛り上げることができる。

②金属チューブを第1次成型用割型に嵌合し、ラックを形成する部分にプレス型を押しつけ、平坦な平坦部をつくる(第1次成型体)。

③第1次成型体の平坦部を第2次成型用割型の凹凸条面に向けてに嵌合し、その後に第1次成型体の孔にマンドレルを圧入し、平坦部の裏側から第2次成型用割型の凹凸条に向けて押し上げ、ラックを形成する。

④第2次成型体からマンドレルを引き抜き、次に断面円柱状の芯金をチューブ端部の中空円筒部内に挿入する。

⑤芯金を挿入した後に内周に加工部(ダイス)を有する割型で第2次成型体を挟み込み、圧力をかけて押さえ込みながら前記ダイスを移動し、金属チューブの外周表面の肉を押し伸ばす。

【0016】これにより金属チューブの肉厚は当初の半分以下とかなり薄くなる。以上述べたように本発明にかかる装置及び方法によれば、予めラックを形成しやすいように肉厚の金属チューブを用い、そしてラックを形成した後に端部のチューブの外周の肉を押し伸ばすように構成したので、ラック部がしっかりと厚みを有し、端部が肉薄のものとなるために軽量でありながら従来のラックバーとかわらない機能を持たせることができる。また、本実施例にかかる装置を用いれば圧延工程により加熱される芯金を取り替え、冷却された芯金を用いて次の圧延を行うことができるので、連続的な圧延作業を行うことができる。

【0017】図11、12に示すものはチューブ1の肉厚を薄くするための手段の第2実施例を示すもので、芯金44'が細くかつテーパ状に形成されたものからなり、押出し加工装置48'、49'が金属チューブ1の外周を押し

延ばすタイプのものからなる。本実施例では、芯金44'をチューブ1に挿入してチューブ1の端部外形をテーパ状となし、かかる形成の後にチューブ1の外周に加工装置48'、49'を装着して移動させると、図12に示すようにチューブの肉厚は先端が薄く、中央にむけて次第に厚くなるような構造となる。尚、本実施例では芯金44'の外周面を一般的なテーパのものとしたが、これに限定されるものではなく、図13に示すように段差44'aを複数有すると共に段差間がテーパに形成されたものを用いても良い。

【0018】

【効果】以上述べたように本発明にかかるラックバーの製造装置及び方法によれば、従来の丸棒を成型したものよりも成型が簡単であると共に、ラック部分を肉厚でラック以外の部分を肉薄に成型しているため、強度的に劣ることなく軽量のものを提供することができる。

【図面の簡単な説明】

【図1】 本発明に使用する肉厚の素材からなるチューブの斜視図である。

【図2】 チューブをプレス型にて変形する状態を示す断面図である。

【図3】 変形後の断面図である。

【図4】 変形後のチューブの斜視図である。

【図5】 ラックを成型するためにマンドレルを挿入する状態を示す横断面図である。

【図6】 図5のA-A断面図である。

【図7】 ラック形成後の斜視図である。

【図8】 チューブの両端部を薄化する状態を示す横断面図である。

【図9】 チューブを薄化する装置の拡大断面図である。

【図10】 連続的に芯金を圧入するため装置の斜視図である。

【図11】 チューブを薄化する装置の第2実施例を示す拡大断面図である。

【図12】 チューブを薄化する装置の第2実施例を示す拡大断面図である。

【図13】 芯金の他の実施例を示す側面図である。

【図14】 従来技術の斜視図である。

【符号の説明】

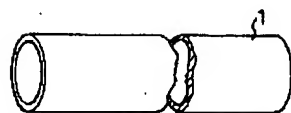
- |                    |          |
|--------------------|----------|
| 1                  | 金属製チューブ  |
| 2, 3               | 両端部      |
| 4                  | 平面部      |
| 5                  | 凹凸条      |
| 11, 12             | 割型       |
| 11a, 11b, 12a, 12b | 対向面      |
| 11c, 12c           | 円弧面      |
| 13                 | 角状プレス型   |
| 31, 32             | 第2次成型用割型 |
| 31a, 32a           | 凹入孔      |



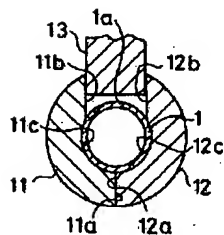
31b, 32b 凹凸部  
 31c, 32c 半円形部  
 33 マンドレル  
 33a 流路  
 33c 傾斜部  
 33d 先端  
 41a 流路  
 41 アダプター  
 42 ストッパー

\* 44 芯金  
 46 加工部  
 48, 49 割型  
 50 通路  
 52 ディスク  
 54 駆動装置  
 56 ロッド  
 58 丸棒  
 \* 58a ラック

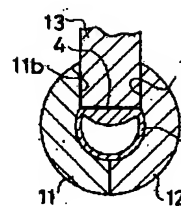
【図1】



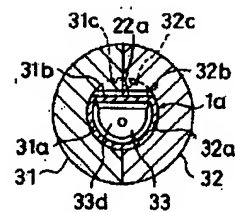
【図2】



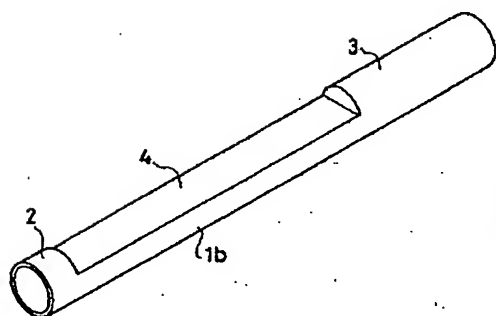
【図3】



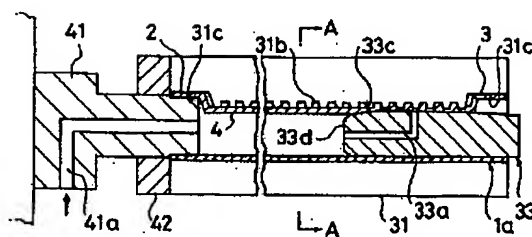
【図6】



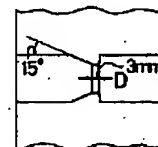
【図4】



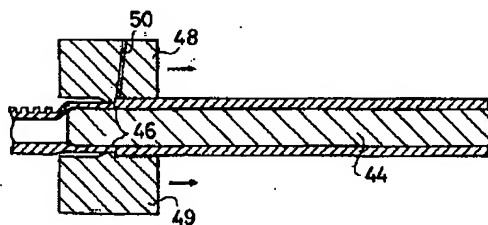
【図5】



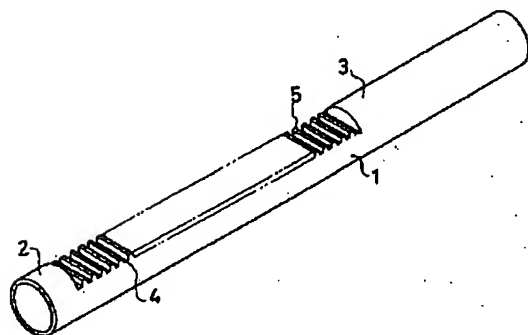
【図9】



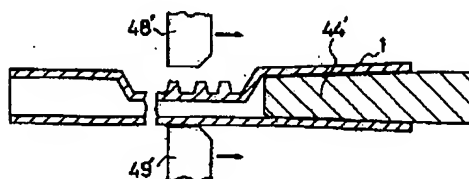
【図8】



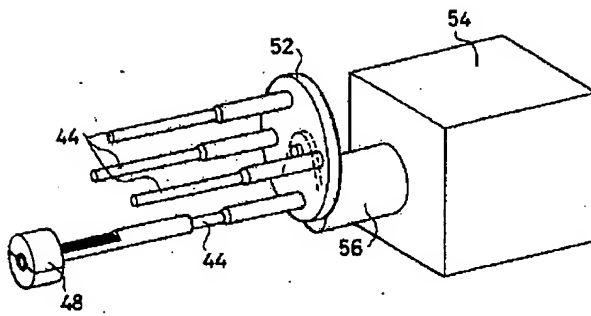
【図7】



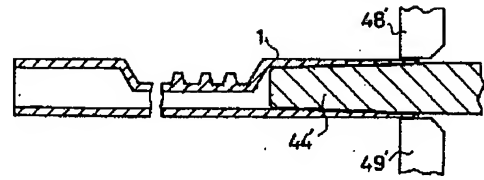
【図11】



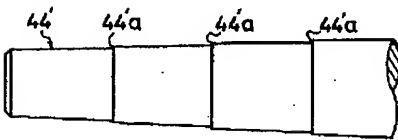
【図10】



【図12】



【図13】



【図14】

